The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

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THE CHEMICAL AGE offices are closed on Saturdays in accordance with the adoption of the five-day week by Benn Brothers, Limited

VOL. XLIV. NO. 1129 February 15, 1941 Annual Subscription, 21s. Overseas, 26s.

Protein Chemistry

THE slow and painstaking growth of chemical knowledge is well illustrated by the story of the chemistry of the proteins. These are, for the most part, bodies produced by organic growth such as hair, muscle, tendon, skin, silk, egg albumen, hæmoglobin, and so forth. Some have industrial applications. The manufacture of cheese, the preparation of glue, the tanning of skins, the discovery that ammonia can be obtained by the distillation of horn or of dung, the use of egg white, blood and gelatine for the clarification of turbid solutions and the coagulation of protein foods by heat are all applications of protein chemistry.

Modern protein chemistry dates from 1820, when Braconnot isolated the amino acid glycine from gelatine by hydrolysis with sulphuric acid, although the structure of glycine itself was not determined until some years later; and throughout the nineteenth century chemists were discovering the amino acids one after another, and isolating them from proteins by decomposition. Although chemical analysis has shown marked dissimilarities between the proteins, Dr. Astbury, in his Jubilee Memorial Lecture, has been able to show that X-ray analysis reveals a striking similarity between proteins of very dissimilar origin, appearance and characteristics. This was probably an important clue to the new structural views he has formulated and which were put before the members of the Society of Chemical Industry " for the first time on any stage."

Prolonged studies have led to the conception that proteins consist of amino acids linked through the amino group of one to the carboxyl group of the other with loss of water, thus forming a substituted amide; further, the secondary valencies present at the various points cause the molecule to assume a definite pattern which is characteristic for each protein. Often their molecular weight is a simple multiple or sub-multiple of 34,500. The lowest molecular weight known for a real protein is 17,000, while hæmocyanin from a snail gave a molecular weights of over 5,000,000. Nevertheless only a dozen graded steps are required to proceed from the lowest member to the highest. There are thus only a very limited number of molecular weights or particle sizes, as determined by the ultracentrifuge, and chemically different proteins may have the same molecular weights. Any theory of protein structure must account for these facts. It must accept a protein molecule composed largely, if not entirely, of chains of 15 to 300 amino-acid residues joined in peptide linkage; it must also explain the definite orientations in space of these residues whereby the side chains are alternately on one side or the other of the main groups; it must explain the structure of the many proteins which are globular in solution; it must explain how it is that proteins even though different in chemical constitution show a similarity of behaviour which suggests some central plan in the arrangement of the amino-acid residues; and it must explain the extensibility of the protein chain whereby it may be doubled in length without fracture by simple stretching.

Analyses made by X-rays have shown that in nature the crystalline state is far more common than has generally been supposed. Not until the problem of the structure of cellulose fibre had been solved was X-ray analysis used with success upon the proteins and then Meyer and Mark suggested that silk fibroin is constructed from polypeptide chains lying roughly parallel to the fibre axis and clinging together to form long thin crystalline micelles. They further suggested that the glycine and alanine rests of fibroin follow each other alternately in the polypeptide chains, and that if these were fully extended, each peptide rest should occupy a length of 3.5Å. Some proteins, *e.g.*, hair would not fit into this pattern, however. Dr. Astbury, however, showed by X-ray photograph that an intramolecular transformation of hair keratin takes place on stretching, an increase in length of 100 per cent. being attainable without any permanent breakage in the structure. The basis of this remarkable degree of elasticity of mammalian hair is that of a molecular spring. The molecules appear to be often normally in a folded position endowed with inherent long-range elasticity. Dr. Astbury recalled the difficulties of explaining the known facts here set forth and cited, as an analogy, the chaotic state of aromatic chemistry before the discovery of the benzene ring. It only needed, he suggested, a discovery of parallel significance to put protein chemistry into a similar state of order. This discovery he believes that he has made, and chemists will look forward to studying his theory when he presents it in print with the orderly scientific proof that it deserves. Since his lecture is to be given at other places, it would perhaps be unfair to indicate more clearly what is the solution that Dr. Astbury proposes; besides, it has not yet been subjected to minute chemical and physical chemical examination by other experts working in the same field. Nevertheless, those who were privileged to hear Dr. Astbury's Jubilee Memorial Lecture delivered may come to congratulate themselves at having been present at the establishment of another milestone, perhaps the most important yet, in protein chemistry.

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NOTES AND COMMENTS

The Petroleum Man

A FUTURE dominated by the products of petroleum was visualised by Dr. A. E. Dunstan, chief chemist of the Anglo-Iranian Oil Company, in a paper on "Oil and the War," delivered to the University of Birmingham Mining Society on Friday last week. He conjured up a character entitled "the petroleum man," and outlined the kind of life he would lead, surrounded by petroleum products. From petroleum he would obtain plastic bricks and tiles to build his house, and fibre for his clothes; he would heat his house with bottled gas and kerosene. When he rose in the morning he would first put in his plastic teeth; he would breakfast on synthetic food, even butter, made from petroleum. His office would be almost entirely furnished with petroleum products. Synthetic alcohol made from petroleum would quench his thirst, and he might nourish himself with a petroleum chop. When he was dead, only five gallons of petroleum would be required to cremate him. Speaking more seriously, Dr. Dunstan enlarged on the cardinal importance of oil fuel in war time. Although there was a demand for a fuel of high octane value and high thermal efficiency, there had been few serious attempts made to find out what were the components of petroleum, though Professor Nash, of Birmingham University, had done remarkable work on the analysis of crude oil. The best modern fuel spirit was not obtained from plain petroleum, but was a blend of hydrocarbons, many of which were synthesised. Lubricating oils, too, which nowadays had to stand very high temperatures and pressures, were built up from "chemical bricks," and here again Professor Nash and Dr. Hunter were doing invaluable work.

Wholesale Prices in 1940

THE Board of Trade Index Number for wholesale prices of industrial materials and manufactures for 1940 is given as 138.4 (1930, 100), as compared with 105.5 for 1939. For chemicals and oils the figure is 117.1, as compared with 95.3; for iron and steel 159.2, as compared with 131.5; and for non-ferrous metals 123.2, as compared with 100.4. With an increase in prices of 26½ per cent., iron and steel was among the groups showing the largest increases for the year, while non-ferrous metals (8 per cent.) was among the lowest. Since the outbreak of war there have been four general increases in iron and steel prices, the dates of the increases and the effect on the group index being as follows: November 1, 1939, 8½ per cent.; February 1, 1940, 5½ per cent.; July 1, 1940, 7½ per cent.; and November 1, 1940, 9½ per cent. Most of the items included in the group were covered by the control orders under which these increases were made. The only quotations in the group to show lower average prices in December, 1940, than a year earlier, were those for tinplates, prices tending to decline up to November, 1940, when the increase was not sufficient to offset the aggregate fall of the preceding months. In the chemicals and oils group a rise in prices of 16 per cent. was recorded for 1940, the rise for the period August-December, 1939, being 13½ per cent. For sulphuric acid, miscellaneous chemicals and fertilisers the aggregate rises during the year amounted to between 25 and 30 per cent. During the same period coal-tar products and paint became dearer by about 17½ and 15 per cent. respectively. The prices of soya oil and palm kernel oil were advanced by £6 per ton in February, representing increases of nearly 20 and 30 per cent. respectively. The price of household soap was advanced by 12½ per cent. in November, 1939, and by 11 per cent. in February, 1940. There were increases in 1940 of about 11 per cent. for motor spirit, 17½ per cent. for burning oil, 24 per cent. for fuel oil and 22 per cent. for lubricating oil.

Motor Fuels from Carbonisation

THE recent announcements that a scheme has been introduced to promote the use of creosote and other tar oils as fuels for commercial vehicles indicates the importance attached by the Government to the home use of the products of carbonisation of coal. This scheme, which came into operation on January 24, is designed to foster experimental work on these oils as well as to encourage their use. The rational utilisation of home fuel supplies has never been considered seriously by any Government Department, although fuel technologists have frequently insisted that this should be done. When coal tar products are not readily saleable and storage capacity has been filled, the tar distiller quite naturally turns to any outlet which will enable him to continue operations and provide some sort of return. Boiler firing is quite a normal outlet in these circumstances. That is no doubt unexceptional as a temporary measure in times of peace, though even here it may well be asked whether the tar industry is not behindhand in undertaking research to discover new uses for those products in which there is a periodic slump. At the present time, however, it is essential that home produced fuels should be used wherever possible and to the best advantage. For "rough" uses such as boiler firing we should undoubtedly use home produced coal of which supplies are more than adequate; we should reserve our liquid products for those uses for which they are better designed than coal, and there could be no better use than the internal combustion engine wherever the tar distiller's art or the skill of the engine designer can make them suitable.

TILES FROM PLASTICS

The first important use of plastics in interior structural decoration has been announced by the Monsanto Chemical Co., St. Louis, Missouri, U.S.A., with a display of a plastic tile moulded from its new material Lustron, a polystyrene product. The tiles are translucent or transparent and made in a wide range of colour; they are extremely resistant to chemicals, water, and atmospheric conditions. They are produced as shallow blocks which can be bolted together by wire fasteners or joined with a cement.

The "Total" Treatment of Process Water

Developments in Ion Exchange Materials

by G. S. RANSHAW

AN adequate supply of water of reduced or modified chemical content is a growing necessity in a large number of industries, both for boiler feed and for process purposes, and the utilisation of ion-exchange mechanisms was proceeding apace up to the outbreak of war. A few years ago the only base exchange materials used on any large scale were the natural alumino-silicates such as the zeolites—bodies characterised by an ability to exchange certain of their cations for those of a saline solution in more or less prolonged contact with them. Other materials are now marketed, however. Some of these are bodies which, like the zeolites, exchange cations; others, more recent still, exchange the anions of solutions in which they are in contact. Some are of mineral origin, natural or synthetic; others are natural or *synthetic organic* substances. It is with the italicised class that we are chiefly concerned here, since these latest synthetic resin types, exercising as they do the dual function of anion- and cation-exchange, afford, in suitably designed installations, a close approach to the solution of the problem of the "total" treatment of water, besides having subsidiary applications which may assume considerable importance.

Cation-Exchange Materials

The cation-exchange materials of mineral origin comprise the "base-exchange" substances of common parlance. As natural hydrated alumino-silicates of sodium, potassium, etc., they occur as minerals of the zeolite class and possess the general formula MeO, Al_2SO_3, $nSiO_2$, mH_2O, where Me can be K, Na, Mg, Ca, Ba, and where n varies from 3 to 6 and m from 2 to 6. Synthetic zeolites are prepared, in principle, by precipitating an alumino-silicic acid, *e.g.*, by treating sodium silicate with aluminium sulphate, the product so formed having all the qualities of natural zeolite but enhanced powers of cation-exchange. Other processes for the preparation of amorphous salts of alumino-silicic acid have been patented, these being formed either by fusion or by precipitation in alkaline media, using silicates and aluminates of soda; acid and alkaline treatment of certain blast-furnace slags is also resorted to.

All these bodies serve to effect the replacement by sodium of the *Ca* and *Mg* ions of those salts constituting the hardness-forming elements of water. In effect, if a solution, even very dilute, of a *Ca* or *Mg* salt is passed over a bed of natural or synthetic zeolite an exchange of the *Ca* or *Mg* ions for the sodium of the silico-aluminic complex occurs. When the zeolite mass has thus been deprived of the major part of its sodium, the influx of raw water can be arrested and the zeolite "regenerated" by a reversible process, *e.g.*, contact with a sodium chloride solution for a predetermined period. Thus the *Ca*, *Mg* ions of the "exhausted" zeolite are replaced by *Na* ions from the brine and, after being rinsed free from precipitated *Ca*, *Mg* salts the material is again ready for use.

Industrial cation-exchange materials in the organic category also possess interest. These have the humic acids as their basis, the classical method of preparation consisting in the extraction of lignite with concentrated sulphuric acid. Besides possessing all the properties displayed by the zeolite exchangers, other advantages accrue. In the first place this organic ion-exchange material can be used with hot solutions, in contradistinction to the zeolites which cannot well withstand the contractions and expansions accompanying variation in temperature. Further, these bodies not only have the ability to exchange cations, but are also able to exchange *hydrogen* for the cation of the saline constituents in hard water. Thus, whilst the zeolitic exchangers exchange their sodium ions for the cation of the *Ca* and *Mg* salts in hard water, *i.e.*, only transform an insoluble salt into a soluble one, the organic bodies described, in their capacity as H-exchangers, eliminate the major part of the *Ca* and *Mg* salts from water.

Such exchangers, therefore, go further in the matter of water-treatment than the zeolite materials, in that they diminish the actual salt content of the water and thereby, in the case of boiler feed-water, reduce incrustation or scaling. They also reduce the content of soluble carbonates in the water of boilers; this is very desirable with a view to reducing caustic embrittlement.

The composition of the humic acids, identified as oxycarbonic aromatic compounds, led Adams and Holmes, two chemists of the Teddington laboratory, in 1934, to investigate the possibilities of preparing bodies of analogous constitution synthetically. They employed the tannins, which were rendered insoluble by condensation with formaldehyde or other aldehydes, and were able to obtain products which possessed cation-exchange ability, but were relatively costly and had other defects. On the basis of their work the I.G. Farbenindustrie attempted to creat synthetic cation-exchangers of similar type and the first patent of a series describes a process resembling that of the Englishmen in that the condensation of phenols and polyphenols is effected with aldehydes in presence of certain acids or their salts. In another patent the same firm sulphonated the product resulting from the condensation of aromatic derivatives and aldehydes, but in which the OH-groups of the original patent were replaced by amine groups. All these products, however, had the same disadvantages as those quoted above. More successful developments from subsequent work are described later.

Anion-Exchange Materials

The use of anion-exchange materials, both of mineral and organic origin, is more ancient than that of cation-exchange materials, but their interest is largely historical and they must be passed over here. In considering modern synthetic organic anion-exchangers, however, we return to Adams and Holmes. Probably because of the defects of the synthesised bodies mentioned in the preceding paragraph, these workers next tried to employ proteins condensed with formaldehyde as anion-exchangers, hoping to augment their exchange capacity. Failing in this they continued with bodies richer in amine functions, notably the aromatic amines which, with formaldehyde, gave anion-exchangers with an exchange capacity superior to that of the proteins, alone or condensed by the same processes (*cf.* condensation of aromatic phenols and formaldehyde to give cation-exchangers). However, these resin bodies, in the form of their chlorides, were somewhat soluble in water, a disadvantage extending to their sulphates and salts generally. Acid water, therefore, when de-acidified by these bodies, retained anions in solution up to the limit of solubility of their salts.

Some success, however, accrued to a French concern's work in an effort to augment the exchange capacity of wool and other protein materials without affecting their inherent stability. Thus, they esterified the acid functions of the proteins in order to liberate the amine functions; at the time of the esterification a part of the amines themselves is alkylated in such a way that the basicity is also accelerated, giving an accelerated speed of reaction with acids in dilute solution.

Finally, the I.G. concern has also tackled the problem of improving the exchange capacities of proteins using products specified by the English workers. In one patent they transform the amino resins into alkylamino resins by treatment with alkylating agents. Their products had a pronounced basicity, but their solubility was unsatisfactory and their price prohibitive. Another process of the same firm describes the treatment of the Adams and Holmes resins with cyanamide. Consideration of the latest work in connection

with both cation- and anion-exchange bodies of this type is reserved for the next section.

Anion- and Cation-Exchange Resins

The familiar types of synthetic resin are chemically inert bodies. This inertness is striven after in the manufacturing process which seeks to eliminate all acid or basic residual valencies. Resin exchange bodies, however, are chemically very reactive. Their fundamental character as high-molecular acids or bases is carefully maintained during manufacture and is usually accentuated by the inclusion of special exchange-active groups. The structure of these resins is that of gels; in consequence of their large internal surface the reaction capacity of these gels is intensified (*cf.* silica gel *vis-a-vis* ordinary quartz). Figs. 1 and 2 explain their chemical structure, the first typifying an acid, the second a basic resin. The structure of the first will be seen to correspond, so far as the ω-sulphonic acid group is ignored, to the phenol type of resin, whilst the second resembles an aminoplast.

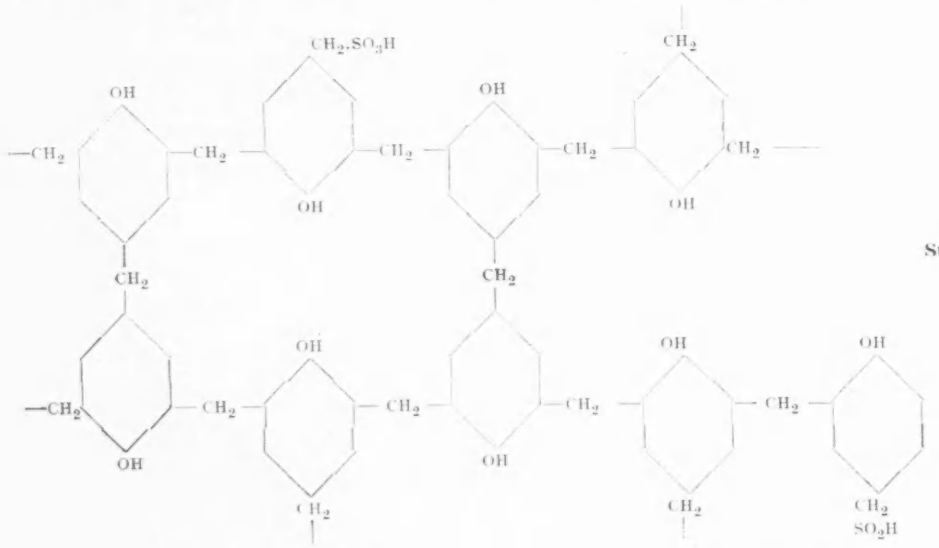

Fig. 1.
Structure typical of a phenol resin.

The following equations aim to show how the exchange resins, according as they have acid or basic character, can act reversibly as cation or anion exchangers.

(1) $Na\text{-resin} + CaSO_4 \rightleftharpoons Ca\text{-resin} + Na_2SO_4$
(2) $H\text{-resin} + CaSO_4 \rightleftharpoons Ca\text{-resin} + H_2SO_4$
(3) $Ca\text{-resin} + 2HCl \rightleftharpoons H\text{-resin} + CaCl_2$
(4) $H\text{-resin} + NaCl \rightleftharpoons Na\text{-resin} + HCl$
(5) $H\text{-resin} + NaOH \rightleftharpoons Na\text{-resin} + H_2O$
(6) $OH\text{-resin} + HCl \rightleftharpoons Cl\text{-resin} + H_2O$
(7) $SO_3\text{-resin} + 2NaOH \rightleftharpoons OH\text{-resin} + Na_2SO_4$
(8) $Cl\text{-resin} + CaSO_4 \rightleftharpoons SO_3\text{-resin} + CaCl_2$

(1)–(5): Cation-exchangers; (6)–(8): Anion-exchangers

If a solution with a hardness-forming constituent, *e.g.* $CaSO_4$, as in (1) and (2), reacts with exchange material present as the sodium or acid resin, transformation of the filtrate (softening) occurs with concurrent combination of calcium and its exchanger. A measure of the "capacity" of the exchanger is the amount of lime given up. Further, if the free acid resin is allowed to act on a dilute solution of a neutral salt, then, in accordance with (2) and (4), the amount of mineral acid liberated serves to measure the "acid strength" of the exchanger. It is obvious that, working with H-exchangers, the *p*H of the solution and the "acid strength" of the exchanger must stand in a certain relationship, and the *p*H range in which a resin exerts its optimum effect has been called its "working range."

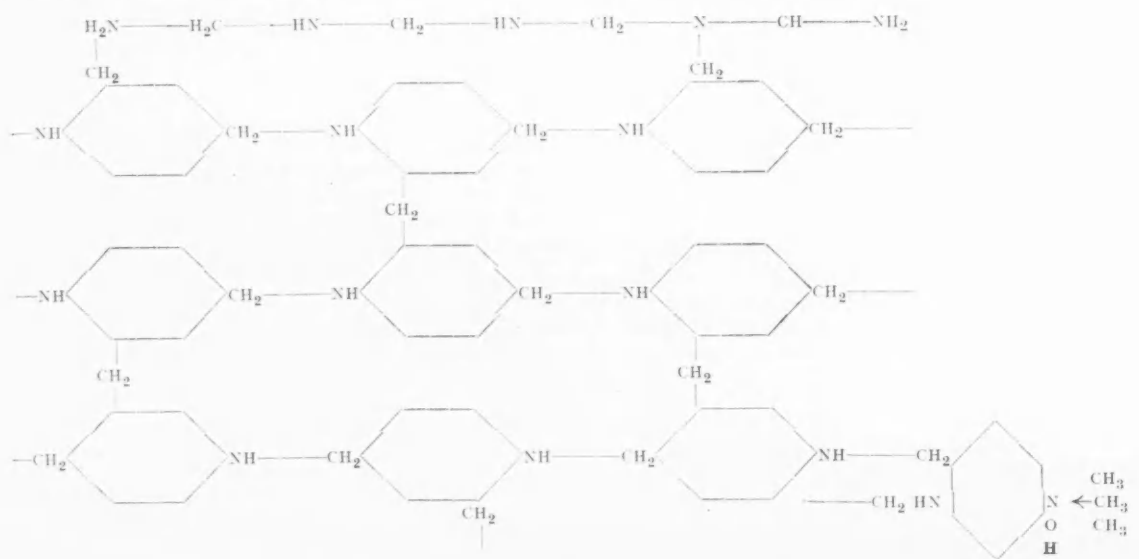

Fig. 2. Structure typical of an aminoplast.

The possibility of incorporating more or less strong acidic or basic groups in resin structures per units of a wide-reaching graduation of the effects and of the development of special resins for special purposes. Some of the latest types of resins with their indices of effectiveness are shown here (Figs. 3 and 4), but concrete evidence of their practical utility is contained in the following synopsis of fields already explored.

A. In the form of their alkali salts the cation-exchange resins are suitable for softening water in the same way as do the known base-exchange materials.

B. Water rich in carbonates can be partially freed from saline content by passage first through a hydrogen exchanger whereby, according to the equation

$$Ca(HCO_3)_2 + H\text{-exchanger} \rightarrow Ca\text{-exchanger} + 2H_2O + 3CO_2,$$

the hardness-forming constituents are fixed by the exchanger, the carbonic acid liberated losing its CO_2 by degasifying. If the water rich in carbonate possesses both permanent and temporary hardness, then, according to the equation

$$CaSO_4 + H\text{-exchanger} \rightarrow Ca\text{-exchanger} + H_2SO_4,$$

mineral acid is liberated. The possibility of suitably controlling the range of action of the resin exchanger is an advantage not common to the ordinary hydrogen-exchangers. By using

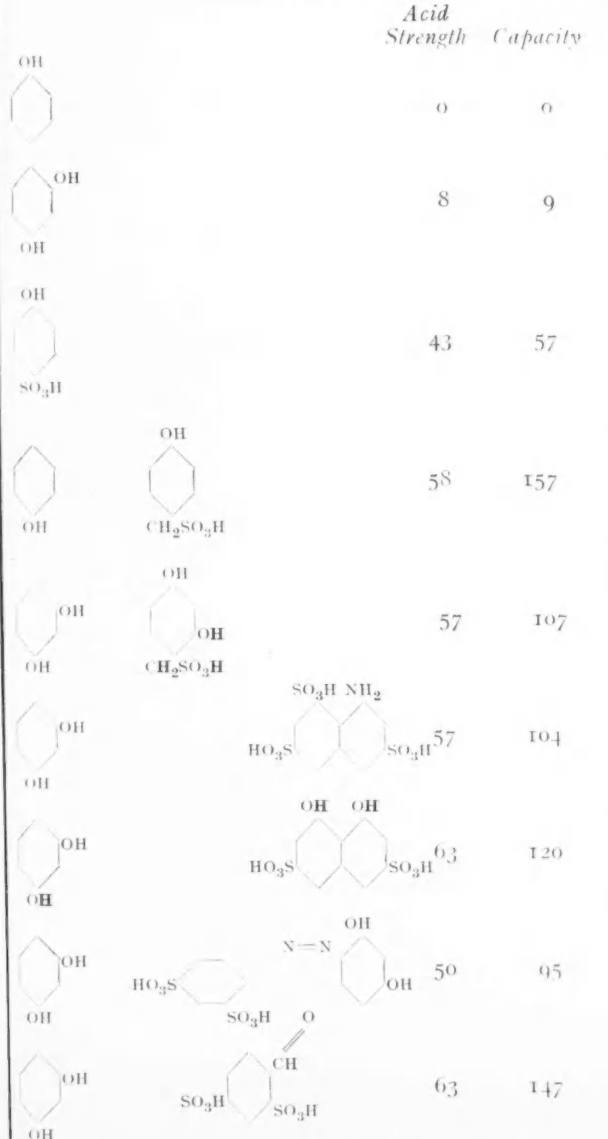

Fig. 3. Development of acid resins by appropriate choice of components.

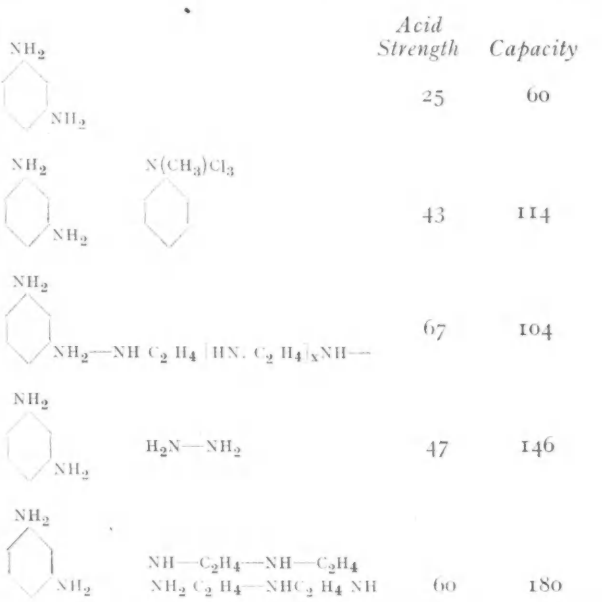

Fig. 4. Development of basic resins by appropriate choice of components.

a buffer filter with a resin exchanger of average acid strength it is possible to get a water which contains practically the whole carbonic acid in free form, while the mineral acids remain in the filtrate in the form of their alkali salts.

C. Complete removal of all salts from water is made possible by the following two-stage process:—

1. $CaSO_4$ + H-exchanger $\rightleftharpoons$ H_2SO_4 + Ca-exchanger
   NaCl + H-exchanger $\rightleftharpoons$ HCl + Na-exchanger
   [Regenerate with HCl]
2. H_2SO_4 + OH-exchanger $\rightleftharpoons$ $2HOH$ + SO_4-exchanger
   HCl + OH-exchanger $\rightleftharpoons$ HOH + Cl-exchanger
   [Regenerate with NaOH]

With two resin types it is possible, by a single filtration (first over a cation-, then over an anion-exchanger) to remove 97 per cent. of the salts from water of average hardness.

D. It is possible by this means to recover valuable bases (alkaloids, pyridine, etc.) from dilute solutions; also to recover dilute acids (by anion-exchange). The separation of basic and acid dyestuffs, removal of small amounts of heavy metals from water, also of solutions of organic materials, should also present no technical difficulties.

New Oil-Cracking Process

Plants Started by Standard Oil Co.

THE Standard Oil Co. of New Jersey are reported by Reuter to have announced a new fluid-catalyst process for the cracking of petroleum, which simplifies production, lowers operating costs and improves the quality of the petrol obtained. The company has started the construction of three large plants of the fluid-catalyst type, and one big competing company is also building a plant under licence.

The company has abandoned the refinery building plans authorised two months ago and is substituting the new-type plants now under construction in Texas, New Jersey, and Louisiana. Each plant will have a daily capacity of 6000 barrels. The fluid-catalyst patents are entirely American-owned and available to all domestic companies.

The January issue of *Deco Trefoil*, published by the DENVER EQUIPMENT CO., of 493a Northolt Road, South Harrow, Middlesex, includes interesting notes on antimony and pumping.

Starch Conversion Products

A Varied Selection for the Process Industries

MUCH attention continues to be given to the subject of starch conversion by chemical reactions which generally involve some measure of molecular degradation. The cold-water-soluble starches introduced some years ago are intermediate in molecular weight between undegraded starch and glucose and are the result of limited hydrolysis. A soluble starch prepared under specific *p*H conditions by a two-stage process has now been used in making a glucose syrup which has no tendency to crystallise in storage and is free from bitter taste.[1] The first stage in solubilisation consists in hydrolysis of the starch suspension with boiling hydrochloric acid under conditions yielding a paste with a *p*H of 1.6 to 1.8. In the second stage the paste is digested under steam pressure until the dextrose equivalent content is of the order of 45 to 55 per cent. This partially saccharified starch product is now subjected to enzymatic hydrolysis, using the spores of a fungus enzyme (*Aspergillus niger, Aspergillus oryzæ, Rhizopus nigricans*, etc.) which has been grown on sterilised bran. The hydrogen-ion concentration to be maintained throughout this stage will depend upon the enzyme selected for the hydrolysis.

Potato Starch

Potato starch might be used more extensively as a source of glucose. Higher yields of high-grade glucose are obtained with a minimum of hydrolysing acid if the sliced undried potatoes are first washed with pure water to dissolve out mineral substances which appear to exercise a deleterious buffer action upon the acid. Potatoes which have been washed free of detectable mineral matter in, say, a maceration battery, were found to undergo quantitative conversion to glucose after cooking with extremely dilute sulphuric or hydrochloric acid for 90 minutes at 145° C.[2]

Starch derivatives forming solutions of relatively high viscosity in water have been obtained by reaction with a variety of agents such as allyl chloride, ethyl chloride and diethyl sulphate (B.P. 454,963). Products of still higher viscosity have now been prepared by treatment with β-β'-dichloroethyl ether,[3] and the process can also be applied to dextrinised starch (British gum) and derivatives like starch acetate and propionate, or starch glycollic acid. The new products dissolve in cold water to form thick pastes of value in textile printing, cosmetics, medicinal emulsions, etc. In neutral solution the reaction product of starch glycollic acid with the dichloroethyl ether replaces ten times its weight of unmodified wheat starch in forming a solution of given viscosity. Moreover the latter cannot be dissolved in the cold.

So-called "thin-boiling" starches are in demand in some industries. They are required to form hot pastes of low viscosity, but with a high solid content which causes them to set readily when cooled. An ordinary acid-hydrolysed starch is not satisfactory. The desired object can be achieved by treating starch at a moderate temperature with calcium peroxide (or a mixture of lime and hydrogen peroxide) for 24 to 28 hours.[4] It is thought that the hydroxyl groups in the starch molecule are oxidised to carboxyl groups and that a calcium salt of the new acid is formed.

REFERENCES.

(1) B.P. 517,892; A.E. Staly Manufacturing Co.
(2) B.P. 519,268; Les Usines de Melle.
(3) B.P. 520,625; E.I. du Pont de Nemours.
(4) B.P. 530,344; Corn Products Refining Co.

Nitrogen in Austria

New Plant in Construction at Linz

CONSTRUCTION of the first important nitrogen plant in Austria (Ostmark) is to be completed as soon as possible so that production may begin this year, and details of its organisation are included in the December issue of the Mineral Trade Notes of the U.S. Department of the Interior, from a statement by the American consul at Vienna. The new nitrogen plant, founded and promoted by the Stickstoffwerke Ostmark A.G., and financed by a loan, is to be at Linz, and will utilise gas from the coke-ovens of the Hermann Goering Werke there, by means of a special process invented by the I.G. Farbenindustrie. The Hermann Goering Werke, which in 1939 absorbed the Alpine Montan Co., is the large company that converts low-grade ore and recently built a new plant near Linz. The fertiliser to be manufactured will be used chiefly to respond to increasing demands of agriculture in Austria.

The Stickstoffwerke Ostmark A.G., which has a share capital of RM. 35,000,000, is closely allied with the nitrogen industry of the Old Reich. Its principal shareholders are the I.G. Farbenindustrie, Bayrische Stickstoffwerke, Süddeutsche Kalistickstoff Werke, A.G. für Stickstoff Dünger, Schwering A.G., Dessauer Werke für Zucker und Chemische Industrie, and Gräflich Schaffgetschen Werke. Distribution of output is to be handled by the Stickstoff Syndikat at Berlin.

To finance the new plant the Stickstoffwerke Ostmark A.G. is offering to public subscription a 4 per cent. loan of RM. 25,000,000 at the price of 98.75 per cent. The rate of interest offered is exceptionally low for any but a government loan in Germany, and it is suggested that, in inviting the public to subscribe at this rate, the promoters are probably relying on the fact that one of the principal shareholders of the new company, the I.G. Farbenindustrie, constitutes a strong background of security for the issue.

Hydrogen Permeability

A Study of Synthetic Rubber Polymers

THE number of synthetic rubber polymers characterised by elastic extensibility is constantly increasing. The fact that these materials possess physical characteristics suggesting their usefulness as gas-impeding films in balloons, with the added advantage that several of them have been shown to be less permeable to gases than rubber, has stimulated further interest in new types of these materials. At the request of the Bureau of Aeronautics of the U.S. Navy Department, the National Bureau of Standards recently measured the permeabilities of these polymers to hydrogen. The following materials were found to diminish in permeability in the order in which they are listed: Natural rubber, Perbunan, Neoprene G, Vistanex, Thiokol Dx, and Pliofilm.

The permeabilities were determined at various temperatures, and the increase in the rate of permeation with increase in temperature was found to be exponential in all cases. The activation energies of permeability for hydrogen were shown to be about 6800 cal/mole for natural rubber and 8400 to 9500 cal/mole for the synthetic substances. A possible explanation for the magnitude of the energy requirements of the synthetic materials lies in the differences in their molecular structure.

In last September's issue of the *Journal of Research*, published by the U.S. National Bureau of Standards, T. P. Sager, of the Bureau's Chemistry Division, emphasised the fact that the practical application of these materials is conditioned by properties other than their permeability to gas, and that in this respect no material thus far commercially available may be regarded as ideal. It is promising, however, that many synthetic materials are capable of great variations in the physical properties which affect their utility but do not appreciably alter their typical rates of penetration.

Notes from Works Safety Jottings

Removing Contributory Causes of Explosions

by JOHN CREEVEY

THE hazard of explosion in chemical plant can arise from a number of causes, but primarily is either a matter of pressure conditions, the explosive or inflammable nature of the material handled, the unexpected formation of an explosive product, or the formation of an explosive mixture of dust and air. In each case there are contributory causes, and safety depends upon their elimination, or the care exercised towards attaining that end. In some cases there are obvious things which need attention, but sometimes they may be overlooked and it is well to call them to mind occasionally. Explosions arising from pressure conditions are not necessarily caused only by lack of adequate safety precautions in the operation of the plant; they can also be traced to previously undetected weakness in tankwork and pipework, weak joints at flanges, the faulty recording of measuring instruments, defective safety devices, the sticking of valves which may need to be operated at a moment's notice, and bad plant maintenance generally. The presence of explosive vapours may become the cause of an explosion while plant temporarily out of operation is being cleaned or repaired. The unsuspected formation of explosive products, and their subsequent accumulation, can cause an explosion while plant is being dismantled or altered to serve new purposes.

* * *

Numerous instances of explosions occurring in plant at chemical and allied works are recorded in the technical press and literature, and although the circumstances have been placed on record for the benefit of all concerned there is often a tendency to ignore the reading of facts which do not appear to be directly concerned with plant normally used. In due course details of such occurrences are forgotten and when "re-discovered" by accident are often regarded as being too old to warrant further attention. Yet, in this way are often to be noted some unusual circumstances attending an explosion which might be studied profitably in the light of present-day conditions.

* * *

Too strong emphasis cannot be placed on the necessity for cleaning all dismantled plant before converting it for some new use. This is especially the case where the original use of plant parts is not known. It has already been recorded that the unscrewing of a joint on a cooling coil resulted in an unexpected explosion, traced to an explosive deposit accumulated by condensation during previous use and set off by friction. The only knowledge as to previous use was that this particular coil had carried acetone vapour; what was not known was that the coil had formed part of the acetone recovery plant at a works making explosive products. In another case, a deposit of similar nature in a dismantled steel tank was suspected of being the cause of an explosion which occurred when an attempt was being made with a hammer and chisel to remove the flange connecting a pipe. In a third case, the heat from welding operations caused the evolution of inflammable gases by decomposition of a substance which had accumulated as a thin coating upon the inner surface of iron vessels during some previous use. As a precaution against circumstances such as these, the plant parts should have been steamed out before the start of the work of dismantling and converting.

* * *

Means adopted as a safety device have to be reviewed in the light of unusual circumstances. Consider the case of an explosion in a still provided with a water-sealed vent. The still had been in more or less continuous operation for six years on a carbon disulphide plant, where, owing to the corrosive nature of the vapours, it had been found impossible to use a safety valve of the ordinary type and a water-sealed vent was therefore adopted. The explosion was primarily due to pressure, which had become excessive from the freezing of the water in the water-sealed vent during cold weather. It was known that the water had previously frozen during cold weather when the plant was not working, but it was not thought that freezing would occur when the still was in operation, even although the plant was in an exposed position where weather conditions might be severe. The remedy subsequently adopted was to put a jacket on the water-seal, to which steam from the heating coil could be passed when the still was in operation and so prevent the water from freezing, however severe the weather conditions.

* * *

Negligence in shutting down plant sometimes gives rise to conditions which may result in an explosion when the plant is re-started. There is more than one recorded instance of pipes and safety fittings becoming choked by the accumulation of crystals which have sublimed or have been deposited from solution on shutting down; and even where the charge has been run off it has been found that this was done carelessly. Excessive pressure easily occurs and the resistance offered when a pipe becomes choked by a deposit of crystals is far greater than may be suspected.

* * *

The sticking of a valve on a supply pipe which is feeding liquid to a reaction vessel can give rise to trouble. But the seriousness of the circumstances cannot be accurately stated in the absence of knowledge of the reaction concerned. In one case where a valve controlling the flow of an organic liquid into a nitrating vessel could not be closed when desired, the excess of liquid fed to the mixed acids led to an abnormal rise in temperature and this in turn gave increased violence to the reaction which ended in an explosion. In such circumstances where there is additional danger due to the nature of the reaction or the materials handled, it is a wise precaution to provide two valves on the feed pipe, so that a second valve is always available for cutting off the feed if the first is found difficult to close owing to some unforeseen condition. Excessive feed for one of the reactants, however, is not the only cause whereby a reaction may involve dangerous conditions, as control within narrow temperature limits may be effected by continuous stirring and failure in this direction may cause the temperature to increase suddenly by nature of the reaction as well as by local overheating. This was experienced in a case where the belt driving the stirring-gear slipped from its pulley, and led to excessive production in the reaction vessel of an inflammable and explosive vapour. This escaped by way of a safety vent and was ignited by a spark from the switch when the motor was cut off for the purpose of attending to the belt. The circumstances which arise and cause an explosion can become involved, and indirect precautionary measures may ultimately be indicated. In this case there would have been no spark to ignite the vapour if the electric motor, switch and starter had all been of protected pattern.

Sachsenburg sulphur furnaces, with combined water cooling, lighting, feeding and cleaning arrangements, for various uses in the chemical trade, are described in a leaflet issued by the sole manufacturers, G. W. HARRISON AND CO., Napier Lead Works, Laisterdyke, Bradford.

"The Vacustat," an inexpensive vacuum gauge which is claimed to cover a useful range of low pressures and to be very simple to operate, is described in a leaflet issued by W. EDWARDS AND CO. (LONDON), LTD., Allendale Works, Southwell Road, Loughboro' Junction, London, S.E.5.

Chemical Industry in Japan

Increase in Production of Sulphuric Acid

FROM various sources comes news of activity in different branches of the chemical industry in Japan. One of the most interesting items concerns the production of sulphuric acid. With the outbreak of the Sino-Japanese hostilities there was a rapid increase in the consumption of sulphuric acid and this resulted in a temporary shortage, owing to an insufficient supply of pyrites. Following the expansion of pyrites mining, there has been increased production lately, despite difficulties in 1939 at the Matuo Mine, one of the main domestic sources of pyrites and sulphur; indeed, production is reported to exceed demand, but it is expected that before long there will be an increase in the demand. As in other countries, the vanadium catalyst method of sulphuric acid manufacture appears to be increasingly popular in Japan; it is being adopted in almost all new plants. The contact process accounted for 30 per cent. of the total capacity of sulphuric acid plants in 1939. Most of the 45 contact plants employing vanadium catalysts used American types, but seven used the Matsui-Osame catalyst developed at Tokyo University of Engineering. The Kyoto Imperial University has developed another catalyst containing vanadium and phosphorus and this is stated to be ready for industrial exploitation.

Synthetic Fuel Industry

The artificial petroleum industry in Japan and Manchukuo, states *J. Soc. Chem. Ind.*, Japan, is being rapidly developed, despite difficulties in obtaining building materials. Two companies—Artificial Petroleum Production Enterprises, and Imperial Liquid Fuel Industry Promoting Co., Ltd.—have been set up by the Imperial Diet to licence the manufacture of artificial petroleum and subsidise the manufacturers. The first successful industrial-scale pilot plant for the direct liquefaction of coal was put in operation by Chosen Coal Industries Co., Ltd., at its Agochi plant. Already a portion of the product has been put on the market. The Fushun plant of the South Manchurian Railway Co., Ltd., also a full-scale pilot plant, started operating almost at the same time. After twelve years of research, continuous operation of the liquid-phase hydrogenation of coal paste was accomplished in the summer of 1939. In March last, the second-stage hydrogenation of the product from the previous stage was also tested on plant scale. In addition to these pilot plants, several larger hydrogenation units are now under construction or being designed. One other company, the Manchurian Coal Liquefaction Research Institute, established last year, now has a pilot plant under construction at Mukden. It is being supervised by German experts.

Patents of the Fischer process were purchased through the Mitsui Trading Co. in 1936 and a full-sized pilot plant situated at Miike has been operating since June last year. In this plant synthetic gas is prepared by the Koppers gasification process using Miike coal. Three larger plants are under construction at Hokkaido, Amagasaki, and Chinchou. Semi-industrial experiments on the synthetic process are being conducted at the Kyoto Imperial University and the Imperial Fuel Research Institute. The former has a new efficient catalyst composed chiefly of iron compound, and the latter has constructed a reaction chamber for operation at elevated pressure.

The Eian plant of the Chosen Coal Industries Co., Ltd., was the pioneer plant of the low-temperature carbonisation process, which produces low-temperature tar as the main product. Operation started in April, 1932, with a Lurgi retort, but many improvements have since been applied to develop a new type. Among several plants now working, three of them situated at Karafuto, Agochi, and Takamatsu have adopted the Lurgi retort, one plant at Ube uses the Koppers vertical retort, and one Hokkaido plant uses the Shimomura process.

Japanese imports of carbon black continue to advance, notwithstanding Government efforts to produce commercial quantities of the pigment. A review of official import statistics for the first quarter of 1940 shows that Japan took 1,918,600 kin (the kin equals 1.33 lb.), valued at 614,323 yen. For the corresponding periods of 1939 and 1938 the imports of carbon black into the country were, respectively, 1,871,000 kin, valued at 484,285 yen and 1,172,100 kin, valued at 313,615 yen.

Higher Fatty-Acid Compounds

Amides and Nitriles in Industry

COMPOUNDS typified by stearamide and stearonitrile are finding new industrial applications, apart from being intermediates for other technical products such as higher alkyl amines, imino ethers, and amidines.

A new method for synthesising long-chain nitriles from the corresponding fatty acids involves treatment of the acid with ammonia in contact with silica gel at a temperature which must be strictly maintained between 425° and 450° C. This critical temperature range is a feature of U.S.P. 2,205,076 (Du Pont), where it is pointed out that a higher temperature leads to much decomposition into ethylene and higher olefines, while at below 425° C. the acid either passes through the reaction chamber unchanged or is converted into an ammonium salt or amide. The best structural material for the catalyst tube is pure nickel, aluminium being less satisfactory. Commercial stearic acid (a mixture of equal parts stearic and palmitic acids) is converted by this process into a nitrile which is an oily liquid boiling at 160°-180° C. (6 mm.). Useful starting materials of a synthetic character are the fatty acids resulting from oxidation of paraffin wax and other petroleum products.

In a somewhat earlier process developed in this country, technical stearamide was used as the starting point for nitrile manufacture and was converted into the latter by reaction in the melted state with phosgene. The mixture of stearo- and palmitonitrile distilled at 195°-218° C. (17 mm.) and solidified to a white crystalline mass when cooled.

Softening Polyamide Resins

A recent application of stearamide (or lauramide) is to the softening of polyamide resins in sheet form (U.S.P. 2,214,405; Du Pont) in order to facilitate working by the cold process. An emulsified mixture of triethanolamine stearate and lauramide is used as an improving agent for transparent cellulose paper with which it is incorporated in process of manufacture. A very small percentage of the lauramide mixture is found to render transparent cellulose sheets more amenable to sticking with ordinary adhesives. Normally, as is well known, the smooth surface of the material is a serious obstacle to good adhesion, especially when the material is to be fixed to glass or other smooth surface (U.S.P. 2,206,046; Du Pont).

Catalytic polymerisation of long-chain nitriles has been studied in recent years and gives rise to viscous oils of possible value as lubricants. According to U.S.P. 2,175,092 (Armour and Co.), numerous catalysts are effective; they include aluminium chloride, zinc chloride, sulphur chloride, and some phosphorus-containing compounds. Products with special properties are formed by polymerisation in presence of two or more catalysts. A mixture of 133 parts palmito-stearonitrile and 17 parts aluminium chloride was heated first for 3 hours at 100° C. and then for 0½ hours at 175° C. The reaction mass was hydrolysed with ice and hydrochloric acid, and a heavy, viscous oil isolated by steam distillation.

IMPORTS OF CHEMICAL AND PHARMACEUTICAL PRODUCTS into Peru in the second quarter of 1940 were valued at 5,558,000 soles, compared with 4,706,000 soles in the same period of 1939, an increase of 852,000 soles or 18 per cent.

Glasgow Starch Works Disaster

Fatal Accidents Inquiry

A FATAL Accidents Inquiry into the cause of the disastrous accident which occurred in the starch works of Messrs. James A. Morrice (James Anderson and Co., Ltd.), Surrey Street, Glasgow, on October 24 last, was conducted at Glasgow on February 6 by Sheriff J. Wellwood Johnston. The cause of the accident, which resulted in the deaths of 18 persons, remains unexplained. After hearing evidence, Sheriff Johnston gave his verdict as follows:—that on October 24 the victims were engaged in their respective employments at the premises when from an accidental cause, which could not be determined with certainty, explosive combustion occurred, and the premises caught fire, as a result of which the 18 persons were killed or sustained injuries from which they died.

Mr. F. W. Hunt, H.M. Superintendent Inspector of Factories (Scotland Division), said he had made as full an investigation as was possible with a heap of rubble, destroyed plant, and witnesses who could really give no vital evidence. In these circumstances it had been somewhat difficult to formulate any real, positive opinion. There were several theories, all of which could account for the accident without their being able to point to any particular one and say "that is the one." His personal opinion was that the dust-collecting chamber, or the cisterns round about there, was the place where the trouble originated. He felt it had something to do with the dust chamber, because of the nature of the damage done.

The works manager, Mr. W. A. Pullar, described the layout of the factory and the types of machinery used for processing the starch. He said the principal product was gum and textile manufacture. The factory was made up of various sections, some of which were comparatively new. The original building, built of stone, was between 90 and 100 years of age. The boiler, which had been in use in the premises for about 40 years, was cleaned twice a year and thoroughly overhauled each July. Questioned about the creation of dust during the processing of the starch, Mr. Pullar said steps were taken to keep the place clean. Smoking was prohibited. Mr. Pullar went on to describe how he found flames inside the building on the morning of the accident and how he helped to give first aid to some of the employees who were burned. At the close of his evidence Mr. Pullar was congratulated by the Sheriff upon the action he had taken to save life in the factory.

Further evidence was given by workmen at the factory, firemen and police.

The Platinum Metals in 1940

New Catalytic Developments

THE position of the platinum metals in 1940 was the subject of the usual annual review by Mr. C. Engelhard, President of Baker & Company, Inc. Owing to the disorganised state of world markets and restrictions on statistics, the current review deals mainly with the United States market.

In the course of his review, Mr. Engelhard notes an increased interest in platinum and platinum-clad metals in the chemical and allied industries. There are some problems of corrosion arising in these fields which can be overcome only by the use of the platinum group metals. There is an increasing tendency to consider the production of new materials in platinum-lined vessels or equipment built for the purpose. While some of the equipment under consideration is large, industry is finding that platinum, unlike many other materials, has good value when reclaimed.

A new platinum catalyst for the production of sulphuric acid has been developed. Experimental installations have been made of the new catalyst during the year and favourable reports have been received of its efficiency as compared with competitive products. It is believed that this new catalyst will increase the importance of platinum in the sulphuric acid industry. Greater interest has been shown also in palladium as a catalyst. In hydrogenation, especially of organic compounds, palladium or its salts can be used more efficiently and at lower temperatures and pressures than base metal catalysts. There has been a large demand for platinum-rhodium in the form of gauze for the ammonia-oxidation process in the production of nitric acid. Spinnerets of platinum-rhodium are replacing other spinnerets, including those made of platinum-gold, because of their superior resistance to corrosion and abrasion.

Prices, apart from those of iridium, have remained relatively stable during 1940. The price of platinum has been steady at between $36 and $38 per oz. Palladium, since 1935, has been $24 per oz., rhodium, since 1937, $125 per oz., and ruthenium, since 1938, $35 to $40 per oz. The price of iridium has fluctuated and was quoted at $175 per oz. at the beginning of the year, but declined to $125 in September. Increased demand resulted in a higher price during the final quarter and towards the end of the year it was quoted above $275 per oz.

Empire Raw Materials

Year's Work of the Imperial Institute

INQUIRIES for assistance and advice from the scientific departments of the Imperial Institute continue unabated and in spite of a depleted staff the Institute has been well able to cope with the work. These are some of the encouraging points made by the Director of the Imperial Institute, Sir Harry Lindsay, in his annual report for 1940.

It was found that the general run of inquiries has reflected the desire to find within the Empire substitutes for materials now difficult to obtain. Among the most interesting of the materials investigated was a high-quality magnesite from Kenya, an excellent substitute for the Swedish material, and supplies of this are now regularly coming to the United Kingdom. A hæmatite from Sierra Leone, almost micaceous in character (formerly sold to Germany), is now being marketed and used in this country, and is proving a very fair alternative to Spanish material. Diatomite from Kenya and the Shetlands, and vermiculite from Western Australia and Kenya showed good possibilities, and among the vegetable products it was found that tung oil from Nyasaland was worthy of development on a commercial scale, while agar-agar from Malayan seaweeds was promising as a competitor to the Japanese product.

On the other side, help was given to Empire concerns who wished to develop their own products; *e.g.*, a Calcutta firm interested in activated carbon was put into touch with the necessary plant suppliers, and other inquirers were advised as to the use of gas-producer plant and machinery for making paper containers.

Chemical Matters in Parliament

Starch Control

IN the House of Commons on February 6, Sir J. Wardlaw-Milne asked the Parliamentary Secretary to the Board of Trade as representing the Ministry of Food, at what date the Starch (Farinaceous) Control was established; and what was the price of farina pre-war, at one month before control was instituted, and one month after, respectively?

Major Lloyd George: The Farina (Control and Provisional Prices) Order, 1940 (S.R. and O. No. 706) came into force on May 10, 1940. The price of farina ex wharf was: (a) Immediately before the war, from £10 10s. to £11 10s. per ton; (b) on April 10, 1940, from £23 10s. to £25 per ton; (c) on June 10, 1940, sales were "at a price to be fixed." All stocks of farina in the country were requisitioned by the Ministry on dates between August 29 and September 4, 1940, after which the price was provisionally put at £30 per ton and later reduced to £28 10s. per ton, the reduction being retrospective.

Personal Notes

MR. CHRISTOPHER SPEIGHT, analytical chemist at the British Tyre and Rubber Co., Leyland, was awarded the degree of A.I.C. by examination held last month.

MR. R. C. HOLBROOK has been elected president of Wall Chemicals Canadian Corporation, Ltd., manufacturers of oxygen, acetylene and medical gases.

SIR JAMES IRVINE, principal of St. Andrews University, has been awarded the Gunning Victoria Jubilee Prize by the Council of the Royal Society of Edinburgh for his distinguished contributions to organic chemistry.

MR. WILLIAM HARDING JARVIS, analytical chemist for the Boston Deep Sea Fishing and Ice Co., was married at Ashton-under-Lyne this week to Miss Margaret Helen Mogg. Mr Jarvis is one of Fleetwood's gas identification officers.

MR. P. PRITCHARD, a Vice-President of the British Cast Iron Research Association, has been elected President of the Birmingham, Wolverhampton, and Stafford District Employers' Association, in succession to Mr. P. H. Mills, who is now Controller of Machine Tools.

PROFESSOR HERBERT W. GARTRELL, professor of mining and metallurgy at Adelaide University, South Australia, has been elected president of the Australasian Institute of Mining and Metallurgy for 1941. Professor Gartrell was appointed lecturer in mining engineering at Adelaide University in 1910 and succeeded to his present position last year.

MR. J. PARAVICINI, chairman of the Widnes Chamber of Commerce, announced last week that his firm, Turner's Asbestos Cement Co., Ltd., were starting the list of subscriptions from members of the Chamber, in response to the Mayor's appeal for Lord Derby's Air Raid Distress Fund, with a donation of £1000.

MAJOR-GENERAL KENELM CHARLES APPLEYARD, managing director of the Birtley Co., Ltd., and of Koppers Coke Oven Co., Ltd., who served with the B.E.F. in France, has been appointed Director of Emergency Construction. His services have been lent for this purpose by the Ministry of Labour and by the War Office, and it has been agreed, at the request of the Ministry of Labour, that certain of his services in that department will be continued by him.

MR. ROBERT FERGUSON, director and secretary of Kelvin, Bottomley and Baird, Ltd., was presented with an inscribed silver tea-service and salver on January 31, on the occasion of his completion of 50 years' service with the firm. A string of pearls was also presented to MRS. Ferguson. The presentation was made by Mr. A. A. King, senior director of the company, who referred to the splendid service rendered by Mr. Ferguson and the high esteem in which he is held by his fellow directors and the members of the staff. An interesting feature of the meeting was the attendance of six of the workers in the establishment—the oldest worker, Mr. Robert Todd, with sixty-four years' service was unable to be present—all with a record of over fifty years' service, making a total of three hundred and twenty-five years of service.

OBITUARY

MR. HENRY TELFORD, who died recently at Keswick, Cumberland, aged 75, served for 43 years with the United Alkali Company at Widnes and St. Helens before its incorporation with I.C.I., Ltd. He remained with the latter company until his retirement a few years ago, rising to be departmental manager on the administrative side.

MR. WALTER FREDERICK BUTLER who, for over 35 years, conducted a chemical works at Bromley Cross, and was also principal of a similar works at Rochdale for some 20 years, died on February 7, aged 82. Mr. Butler had wide interests in the trade and had paid many visits to Germany and South America.

MR. PERCY FREDERICK HOLMES, J.P., who died last Sunday at Huddersfield, aged 81, was for many years, until his recent retirement, chairman and governing director of W. C. Holmes and Co., Ltd., coal by-product engineers, Huddersfield.

MR. ARTHUR FREDERICK BUTLER, who died suddenly on February 6 at his residence at Little Hadham, Herts, was a very well-known figure in the chemical trade in this country. He was director of Greeff-Chemicals Holdings, Ltd., and one of the managing directors of R. W. Greeff and Co., Ltd., of Bishop's Stortford, London, and Manchester, and during the forty years of his association with R. W. Greeff and Co. was in intimate contact with all sections of the chemical trade. Mr. Butler was also a vice-chairman of the British Chemical and Dyestuffs Traders' Association, and a director of the Association of Manufacturing Chemists.

MR. GEORGE HARRISON GEMMELL, F.I.C., of Gemmell and Thin, analytical chemists, 4 Lindsay Place, Edinburgh, a chemist of distinction in both teaching and municipal service in Scotland, died in Edinburgh on February 1, aged 80. Mr. Gemmell, a native of Birkenhead, was for most of his working life identified with chemistry in Scotland. Besides being lecturer at the School of Medicine in Edinburgh and examiner for the Royal College in the city as well as Professor of Chemistry in the Royal (Dick) Veterinary College, he was public analyst for the three Lothian counties, for Peebles and Clackmannan, and for many burghs. He was also the official analyst for the North British Association of Gas Managers. Mr. Gemmell was the author of *Chemical Notes and Equations* and of numerous communications to the Society of Chemical Industry and the Royal Scottish Society of Arts.

British Chemical Prices

Market Reports

THE demand for general chemicals both for home trade and export continues to be on a satisfactory scale and the tone throughout the market remains firm. Under the Control of Molasses and Industrial Alcohol (No. 11) Order, which came into operation on February 10, the maximum prices for acetic acid and acetone are increased by £3 per ton and £12 10s. per ton respectively. Quotations for methylated spirit and other alcohols and solvents are also increased. Prices in other directions remain steady at recent levels. Among the acid products boric, tartaric and citric are in good request and the demand for oxalic is greater than the supply. Most of the soda compounds are in good call and so far as the potash products are concerned offers are quickly absorbed. A rather better inquiry for coal tar products is reported, an active interest being shown in such items as creosote oil, solvent naphtha and the xylols. There is room for improvement in the market for pitch and cresylic acid.

MANCHESTER.—A fair amount of forward buying of the leading heavy chemical products has been reported on the Manchester market during the past week, whilst spot transactions have been moderately active. A moderate volume of shipping business has also been reported. Generally firm price conditions still obtain, more particularly in those sections where supplies are on the short side, a wide range of values being indicated for second-hand lots. Taking the tar products market as a whole, prices are on a strong basis and a good trade is passing in the light materials and also in crude tar and creosote oil.

GLASGOW.—Trade in the Scottish heavy chemical market remains fairly active for home business. The export trade is still rather quiet. Prices on the whole remain firm with slight increases in some directions, such as acetic acid, which has risen by £3 per ton.

Price Changes

Acetic Acid.—Maximum prices per ton: 80% technical, 1 ton £39 10s.; 10 cwt./1 ton, £40 10s., 4/10 cwt., £41 10s.; 80% pure, 1 ton, £41 10s.; 10 cwt./1 ton, £42 10s.; 4/10 cwt., £43 10s.; commercial glacial, 1 ton, £49; 10 cwt./1 ton, £50; 4/10 cwt., £51; delivered buyers' premises in returnable barrels, £4 per ton extra if packed and delivered in glass.

Acetone.—Maximum prices per ton, 50 tons and over, £65; 10/50 tons, £65 10s.; 5/10 tons, £66; 1/5 tons, £66 10s.; single drums, £67 10s.; delivered buyers' premises in returnable drums or other containers having a capacity of not less than 45 gallons each. For delivery in non-returnable containers of 40/50 gallons, the maximum prices are £3 per ton higher. Deliveries of less than 10 gallons free from price control.

Methylated Spirit.—Industrial 66° O.P. 100 gals., 2s. 0½d. per gal.; pyridinised 64° O.P. 100 gals. 2s. 5d. per gal.

General News——From Week to Week

THE NEW ADDRESS OF THE WHOLESALE DRUG TRADE ASSOCIATION is now Tavistock House North, Tavistock Square, London, W.C.1 (Tel. : EUSton 4581).

BROWN AND FORTH, LTD., chemical manufacturers, 118 Chorlton Road, Manchester, 15, and Magnesium Elektron, Ltd., Clifton Junction, near Manchester, were among the new members elected to the Manchester Chamber of Commerce in January.

THE STORY OF THE PART that chemotherapy has played in the last 20 years of scientific development was the basis of an illustrated lecture given to the Nottingham branch of the Society of Chemical Industry at the Welbeck Hotel, Nottingham, on February 6, by Dr. W. F. Short.

MR. H. KIRMAN (PRESIDENT) presided over a good attendance at the monthly meeting of the Peterborough Engineering Society, held at the Technical School Lecture Hall, recently, when Mr. W. T. Freestone gave an illustrated lecture on "The Nitrogen Hardening of Steel." A discussion followed, and several new members joined the Society afterwards.

QUOTED IN THE *Manchester Guardian*, the "Onchan Pioneer," journal of the internees at Onchan Camp, Isle of Man, gives an interesting trade-census of the internees on January 29 as compared with November 29 last year. In the chemical industry the number of "manufacturers and organisers" interned is reduced from ten to four; and "scientific chemists" number five as against twelve; but "skilled chemical workers" are still seven in number as compared with eight in November.

Foreign News

THE MALAYAN INFORMATION AGENCY in London states that an official cable reports that the local ouput of tin and tin in ore at 75.5 per cent. in December last was as follows: Federated States, 9566 tons; Unfederated States, 280 tons; and Straits Settlements, 19 tons; making a total of 9865 tons.

ALTHOUGH THE HEADQUARTERS of the quinine industry were formerly in Amsterdam, the process of extraction from cinchona bark is still in operation at the largest factory in the world, the Bandoengsche Kininefabriek (Java). Ample supplies are thus available for therapeutic purposes and research work.

PRODUCTION OF SUPERPHOSPHATE in Japan in July, 1940, amounted to 129,742 tons, compared with 153,566 tons in June and 129,248 tons in July, 1939, while production of ammonium sulphate in the same months totalled 105,684 tons, compared with 109,204 tons in June and 109,742 tons in July, 1939. Output of ammonium sulphate in Manchukuo in July totalled 16,462 tons, compared with 17,465 tons and 11,593 tons respectively.

BY THE MELTING-DOWN of nickel coins withdrawn from circulation in Italy it is estimated that 4500 metric tons of nickel have been recovered. Of this about 1600 tons was derived from the one-lira and two-lire pieces, the remainder from the smaller but commoner coins of 20 and 50 centesimi. Paper currency and coins of "acmonital," a steel-nickel composition, have replaced the older nickel coins since October 31 last.

IMPORTS OF POTASH into Brazil in the first half of 1940 were valued at £73,000 (gold), compared with £38,000 (gold) in the same period of 1939, and included 10,660 metric tons from Great Britain and 4120 tons from the U.S.A. Imports of caustic soda in the same period were valued at £181,000 (gold), compared with £109,000 (gold), and included 10,930 tons from Great Britain and 8800 tons from the U.S.A.

UNDER THE STRESS OF WAR, Germany, as the world's largest potato grower, is turning to potato tops as a means of augmenting her native supplies of cellulose. The Halm Cellulose Works at Cröllwitz (Saxony) have developed special methods of processing the tops in order to obtain a cellulose of satisfactory quality for the paper and rayon industries. Although small at present, the maximum output of cellulose, based on the total potato acreage of the country, is expected to be in the vicinity of 500,000 tons per annum. To facilitate the transport of the potato tops to the cellulose factories, a special briquetting machine has been designed which compresses the air-dried material into blocks.

THE CONTROL OF WEEDS AND DISEASES in tobacco plant beds by the use of calcium cyanamide and chloropicrin combined was described in a paper read before the American Association for the Advancement of Science by Clayton, Gaines, Stone and Shaw. Calcium cyanamide gave good control of weeds but not of diseases, while chloropicrin controlled diseases only.

TARTARIC ACID is one of the principal acids imported into Iraq, and supplies have hitherto been derived largely from Italy. Imports increased in 1939 to 74,088 kg. (7676 dinars) from 37,407 kg. (3470 dinars) in 1938. During the first quarter of 1940 imports amounted to 20,336 kg. (2679 dinars) compared with 17,705 kg. (1764 dinars) in 1939.

THE LEADING SWEDISH RAYON-MANUFACTURING concern, Notoddens Konstsilkefabrik, reports a considerable increase in production during the past year as the result of the general expansion of demand for artificial textiles under war conditions. Originally designed for an annual output of 400,000 lb. of yarn, the plant is now being enlarged at a cost of 600,000 kronor with a view to trebling the production.

THE ALUMINIUM CO. OF AMERICA has acquired complete ownership of the American Magnesium Corporation through the purchase of the 50 per cent. interest held by General Aniline Works, Inc. An immediate increase in production of magnesium for defence purposes will be started. General Aniline Works, Inc., is controlled by the American I.G. Chemical Corporation, the American offshoot of the I.G. Farbenindustrie.

EXPORTS OF PYRITES from Spanish mines to United States sulphuric acid plants during the first ten months of 1940 were on a larger scale than in the corresponding period of 1939. Revised United States import statistics for pyrites during the first ten months of 1940 include a fairly large tonnage not shown in preliminary monthly reports, which brings the total United States imports to 371,237 long tons, of which Spain supplied 303,630 tons. Other suppliers were Canada with 67,404 tons and Mexico with 203 tons.

DR. SVERRE PETTERSSEN, Professor of Meteorology at Massachusetts Institute of Technology, claimed, in a recent lecture before the Institute of Aeronautical Sciences, to have evolved a method of clearing fog from airports. He said that a path 150 ft. wide, 30 ft. deep and 1500 ft. long could be cleared of fog by spraying it with the solution of sulphur chloride at the rate of 85 gallons a minute. The chloride, he explained, created an artificial rain through the adherence of the fog droplets to the chemical.

L. E. SMITH, A CHEMIST of the Bureau of Entomology and Plant Quarantine, U.S. Department of Agriculture, has been granted a U.S. Patent (No. 2,127,566) covering the use of phenothiazine as an insecticide. This patent is dedicated to the free use of the public in the territory of the United States Laboratory tests have shown that phenothiazine is even more lethal than lead arsenate to several insects, including the codling moth, and that, unlike lead arsenate, it would not leave dangerous residues on fruit sprayed with it.

JAPANESE EXPORTS OF SODA ASH in July, 1940, amounted to 2300 tons, compared with 1500 tons in June and 4000 tons in July, 1939, while imports during the first seven months totalled 8300 tons, compared with 8767 tons during the same period of 1939. Exports of caustic soda in July totalled 303 tons, compared with 671 tons and 3078 tons respectively, the seven months' figures being 9514 tons for 1940 and 11,486 tons for 1939; exports of sulphur in July totalled 8999 tons, compared with 5603 tons and 2628 tons respectively, and 19,358 tons and 15,415 tons respectively for the seven months.

IMPORTS OF ACETIC ACID into China increased to 931,477 kilograms, valued at 361,150 gold units, in the first eight months of 1940, compared with 444,789 kilograms, valued at 105,979 gold units, in the corresponding period of 1939. The major countries of origin were Japan, with 149,286 kilograms, valued at 40,124 units, compared with 404,190 kilograms, valued at 97,504 units; Germany, with 3465 kilograms, valued at 1803 units, compared with 34,407 kilograms, valued at 7098 units; Holland, with 14,475 kilograms, valued at 6056 units, compared with 2980 kilograms, valued at 556 units; and Great Britain, with 3827 kilograms, valued at 1772 units, compared with 108 kilograms, valued at 100 units.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

County Court Judgments

SCOFIELD, DANIEL L., 28 Storrar Road, Tremorfa, Cardiff. (C.C.J., 15/2/41). Sulphate maker. £10 5s. 0d. November 12.

KENNETH HILL & CO., LTD., R/O. Blastclean Works, Works Road, Letchworth. (C.C.J., 15/2/41). Metallic abrasive manufacturers. £10 2s. 11d. November 28.

Company News

The Egyptian Salt and Soda Co. have declared a dividend of 3s. per share, tax free (last year 2s.).

English China Clays Sales Co., Ltd., have declared an ordinary dividend of 1 per cent. (last year 1½ per cent).

A. Boake, Roberts and Co., Ltd., report an interim dividend at rate of 1½ per cent. net for year to March 31, 1941 (2 per cent. net at corresponding period last year).

Doulton and Co., Ltd., in a preliminary statement show a net profit for year to December 31 last of £31,421 (£61,079). A dividend of 5 per cent., less tax, on ordinary shares has been declared (same).

Universal Asbestos Manufacturing Co., Ltd., announce that a dividend on the 6 per cent. redeemable cumulative preference shares in respect of the period September 2, 1940, to March 1, 1941, will be payable on March 1.

The Eastern Chemical Co., Ltd., announce a profit for the year ended March 31, 1940, subject to taxation of £11,486, after allowing £2217 for depreciation and writing off £1948 expended on renewals and repairs. Debit balance reduced to £37,871. Depreciation reserve is now £26,961. Meeting, 13 Fenchurch Avenue, E.C.3, February 20, at noon.

Chemical Trade Inquiries

India, Burma and Ceylon.—A firm of agents established at Bombay wishes to obtain the representation of United Kingdom manufacturers of the above for India, Burma and Ceylon for industrial chemicals, particularly chlorate of potash, bichromate of soda and potash, aniline, salt, etc. (Ref. No. 40.)

New Companies Registered

Henry Wilkes Chemical Co., Ltd. (365,170).—Private company. Capital £6000 in 6000 shares of £1 each. To acquire the business of a chemical manufacturer carried on by Ernest Wilkes at Eyre Street, Spring Hill, Birmingham, as the "Henry Wilkes Chemical Co." Directors: Ernest Wilkes; Helen Wilkes. Registered office: Eyre Street, Spring Hill, Birmingham.

International Plastics, Ltd.—Private company. Nominal capital of £1000 in 1000 shares of £1 each. Mechanical and electrical engineers, metallurgists, galvanisers, japanners, annealers, enamellers, electroplaters, etc. Directors: Major Keith Trevor, M.C. (chairman); Wilhelm Fischbein; Edk. A. S. Gwatkin; Ralph A. Holden. Solicitors: Richardson, Sowerby and Co., 5 John Street, W.C.1. File number 365,123.

Sun Engineering (Richmond), Limited. (365,044).—Private company. Capital: £1000 in 1000 shares of £1 each. Manufacturers of and dealers in fire-fighting equipment and accessories, including foam pumps and chemical apparatus, general engineers, etc. Directors: William C. Latham; John Lorton; Richard Watson; Geoffrey H. Wilkinson; Edward A. W. Williams. Solicitors: Abbott, Anderson & Co., Dome Buildings, Richmond. Registered office: 383 Richmond Road, Twickenham, Middlesex.

Swan Chemical Co., Ltd. (365,149).—Private company. Capital: £2000 in 2000 shares of £1 each. Manufacturers of and dealers in chemical products made from activated carbon, and other chemical products, compositions, preparations and derivatives, etc. The directors are: Joseph Turner, "Kerridge," Heybridge Lane, Prestbury, Cheshire; Arthur J. Whiteley.

Chemical and Allied Stocks and Shares

DESPITE the opening of the Stock Exchange for an extra hour each day, business in most securities has shown little improvement, although on the other hand, the general undertone was firmer at the beginning of the week, aided by the renewed rise in British funds. Sentiment has continued to be governed by the disposition to await the Budget and also the many important company results which are due to be issued during the next few weeks. Moreover, the market trend has been influenced by a tendency to adopt a cautious attitude, pending the next turn of events in connection with the war news. Confidence in the position and outlook was again indicated by the fact that not more than the normal volume of selling was in evidence. Indeed, many leading securities continued to be held so firmly that they are in short supply in the market, and consequently have been difficult to obtain except at higher prices than those indicated by current quotations.

At 29s. 1½d. Imperial Chemical were 6d. lower as compared with a week ago, sentiment having continued to be influenced more by the possibility of developments in connection with the American assets of British companies than by continued expectations that the forthcoming results will maintain the dividend at 8 per cent. The I.C.I. 7 per cent. preference units, however, became firmer, and were quoted at 33s. 3d. There was also steady demand for preference shares of other leading companies, including those of Turner and Newall, Dunlop Rubber, etc., but with little selling in evidence, they were not in large supply in the market. B. Laporte held their recent rise to 56s. 3d. and business in Fison Packard shares was recorded at 32s. 4½d., while Monsanto Chemicals preference shares transferred around par, and elsewhere Greeff-Chemicals Holdings 5s. units were quoted at 6s. 3d. British Drug Houses were again around 22s. 6d. British Glues 4s. ordinary shares were firm at 7s. on hopes that the dividend may be kept at 10 per cent.; on the last occasion, it may be recalled, a dividend of approximately 17 per cent. was earned. Lever and Unilever were inclined to be reactionary, and in fact, have gone back on balance from 23s. 3d. to 22s. 6d., although the various classes of preference units were quite well maintained. At 65s. British Oxygen were the same as a week ago, but British Aluminium were slightly lower at 41s. 9d.

British Plaster Board remained steady at 13s. 3d. and shares of cement manufacturers were again quite firm, awaiting the financial results of Associated Cement. Wall Paper Manufacturers deferred units, however, went back moderately from 22s. 10½d. to 22s. 6d. Goodlass Wall 10s. ordinary units again transferred around par, and the preferred ordinary shares were firm at 10s. 6d., while business in the 7 per cent. preference shares took place at around 27s. Pinchin Johnson at 19s. 6d. were unchanged on balance, while International Paint kept at 77s. 6d. awaiting the dividend announcement. Barry and Staines were a few pence better at 26s. 10½d. and as regards Nairn and Greenwich, the price improved 1s. 3d. to 52s. 6d. Borax Consolidated deferred held their recent rise to 28s. 9d. awaiting the preliminary statement for the past year's working.

Courtaulds were easier at 31s. 1½d., having reflected the somewhat reactionary tendency shown by shares of most companies with important assets in the U.S.A. which may be concerned in developments for increasing the dollar resources of the British Government. Favourable dividend estimates assisted Dunlop Rubber, which were little changed at 33s. 7½d., while hopes of a forthcoming modification of E.P.T. tended to maintain a fairly steady tendency in Dorman Long, Stewarts and Lloyds and various other leading iron and steel securities. In other directions, a point of interest was further buying of British Oil and Cake Mills preferred ordinary units which improved to 36s. 6d. Boots Drug were 37s. 6d. Movements in "Shell" and other leading oil shares were mostly small and unimportant.

A.R.P. TRAINING BULLETIN

The fourth of the Air Raid Precautions Training Bulletins issued by the Ministry of Home Security contains important notes on measures to counter gas, on high explosive bombs, and on fire-bombs of various types. Among a number of other subjects dealt with is roof spotting, to which considerable space is devoted. Like its three predecessors, this Training Bulletin is intended chiefly for the benefit of instructors, more particularly those in commercial and industrial establishments, who have not the same opportunities as the staffs of local authorities of keeping in touch with the latest developments in air raid precautions. The Bulletins contain the latest information and guidance on the subject. Copies of Bulletin No. 4 will be sold to secretaries of industrial or commercial concerns, on written application to the Stationery Officer, York House, Kingsway, London, W.C.2. The price is 4d. (5d. post free) for single copies. Postage rates for quantities will be furnished by the Stationery Office on application. Further Bulletins will be issued from time to time.

The full spring range of hat and millinery colours issued by the Colour Information Department of S. HUBBARD, LTD., Luton, comprises no fewer than forty-eight attractive examples dyed on woolfelt.